Program Review
1983-84
Newfoundland Forest Research Centre
Canadian Forestry Service
Department of the Environment

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THE CANADIAN FORESTRY SERVICE
DEPARTMENT OF THE ENVIRONMENT

The Canadian Forestry Service (CFS) is the principal source of federal expertise in forestry. Its general objective is to promote the wise management and use of Canada's forest resource for the economic, social and environmental benefit of Canadians.

The following are the main functions of the CFS:

1. providing coordinated federal policies to promote forest industry development and better resource management;
2. providing scientific and technical leadership through research and development;
3. providing and analyzing national and international information and statistics as a basis for policy;
4. aiding in developing and certifying codes and standards of product performance;
5. protecting Canada's forests from foreign posts;
6. supporting provincial forest renewal preograms to insure permanent viability of the forest resource;
7. fostering the potential use of the forest resource for energy; and,
8. contributing to the environmental objectives of the Department of the Environment.

A number of federal agencies are involved in forestry programs, and a Federal Forestry Sector Committee has been established to coordinate federal forest activities. The CFS has been designated the lead agency

In September, 1982, the Canadian Forestry Service assumed responsibility for regional economic development from a forestry standpoint. In this context the service is required to negotiate federal-provincial forest renewal agreements of intensive forest management practices to meet the objective of the federal forest sector strategy. As a result, the CFS is also involved in the development of economic profiles and studies to identify regional and national needs, and development opportunities.

The Canadian Forest Service is composed of a headquarters unit, six forest research centres, and two national institutes. The forest research centres are responsive to regional priorities and maintain close liaison with the respective provincial government forestry departments. They also participate in, and frequently lead, national programs. The national institutes provide the focus for programs of national scope. The headquarters unit comprises three directorates — Research and Technical Services, which plans, directs and coordinates the research and development programs and technical services of the CFS; Forestry relations, Economics, and Development, which handles forestry relations with university, industry and other governments, economic analyses, as well as the coordination of the forestry development and employment stimulation programs; and Finance, Planning, and Administration, which manages the support services of the CFS in planning and program evaluation, finance, administration, and human resources management.

LE SERVICE CANADIEN DES FORETS
MINISTERE DE L'ENVIRONNEMENT

Le Service canadien des forêts (SCF) réunit la majorité des spécialistes fédéraux en foresterie. Son objectif général est de promouvoir l'aménagement et l'utilisation judicieux des ressources forestières du Canada pour le plus grand bien économique, social et environnemental des Canadiens.

Voici les principals fonctions du SCF:

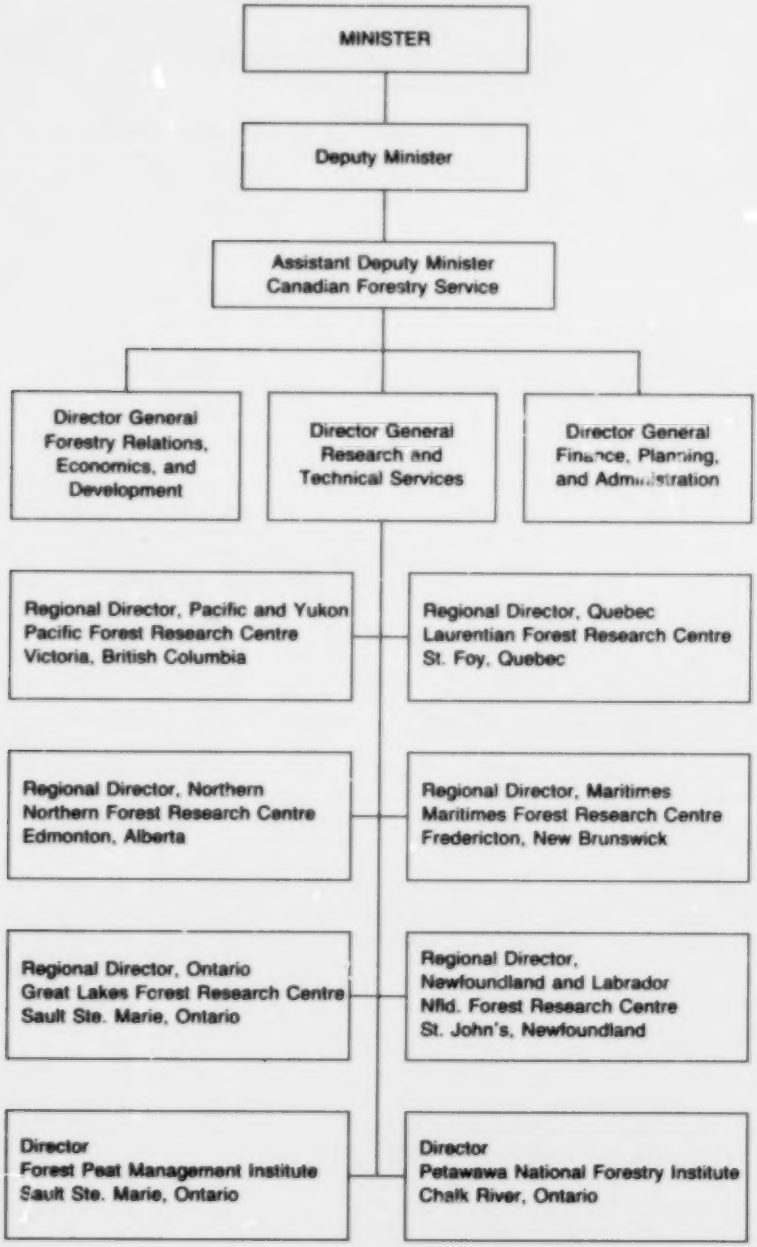
1. fournir des politiques fédérales coordonnées afin de favoriser l'expansion de l'industrie forestière et l'amelioration de la gestion des ressources;
2. fournir une orientation scientifique et technique par la recherche et le développement;
3. fournir et analyser l'information et les statistiques nationales et internationales qui serviront de base aux politiques;
4. aider à la mise au point et à la certification des codes et des normes en matière de performance des produits;
5. protéger les forêts canadiennes en luttant contre les ravageurs étrangers;
6. appoyer les programmes provinciaux de régénération forestière afin d'assurer la viabilité permanente des ressources forestières;
7. parrainer l'utilisation éventuelle des ressources forestière afin d'assurer la viabilité permanente des ressources forestières pour la production d'énergie; et
8. adhérer aux objectifs environnementaux du ministère de l'Environnement.

Depuis septembre 1982, le SCF assume la responsabilité du développement économique régional dans le domaine forestier. A ce titre, il doit conclure des ententes fédérales-provinciales, relatives à la régénération forestière, sur des méthodes de gestion intensive des forêts afin d'atteindre les objectifs de la stratégie forestière du Canada. Le SCF doit conséquemment participer à la mise au point de profils et d'études économiques afin de cerner les besoins sur les plans régional et national, de même qu'aux possibilités de développement.

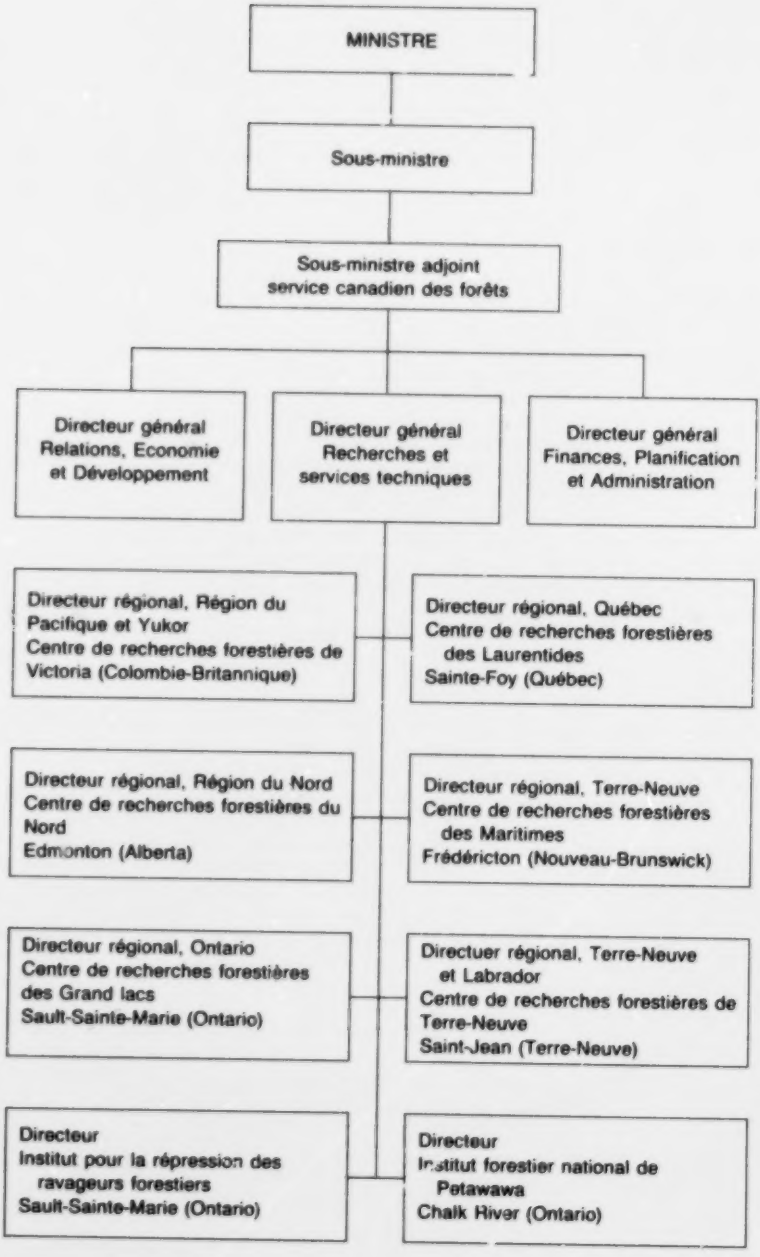
Le SCF comprend une administration centrale, six centres de recherche forestière et deux instituts nationaux. Les centres de recherche forestière doivent répondre aux impératifs régionaux et entretenir une liaison étroite avec les ministères provinciaux des Forêts. Ils participient également à des programmes nationaux dont ils assument fréquemment la direction. Les instituts nationaux sont les foyes des programmes d'envergure nationale.

L'Administration centrale comprend trois directions générales: Recherche et Services techniques, don le rôle consiste à planifier, diriger et coordonner les programmes de recherche et développement ainsi que les services techniques du SCF; Relations, Economie et Développement, qui s'occupe des relations forestières avec les universités, l'industrie et les autres gouvernements, d'analyses économiques ainsi que de la coordination des programmes de développement forestier et de création d'emplois; et Finances, Planification et Administration, qui dirige les services de soutien du SCF dans la planification, l'évaluation des programmes, les finances, l'administration et la gestion du personnel.

DEPARTMENT OF THE ENVIRONMENT



MINISTERE DE L'ENVIRONNEMENT



FOREWORD

This program review of the Newfoundland Forest Research Centre (NeFRC) covers the period April 1983 to March 1984. The various research projects and studies conducted during the year are listed, the achievements are described and lists of publications and related productivity are provided.

The Newfoundland Forest Research Centre is an establishment of the Canadian Forestry Service and is one of six similar regional establishments in Canada. The Centre conducts most of the forestry research in the Newfoundland and Labrador Region and also has the federal responsibility specific to forestry agreements between Canada and the Province.

The objective of the NeFRC is to provide the scientific, technological and economic information and services requred for the improvement, protection and efficient utilization of the forest resources of the province of Newfoundland and Labrador. The work is directed towards satisfying the requirements of the Provincial Government, the forest industry, federal agencies having forestry related problems and other clients of the Canadian Forestry Service. Many of its studies are undertaken jointly with client agencies. The Research Centre attempts to bring the results of research to potential users by publishing information reports, articles in scientific journals and by demonstrations of research results. It further seeks to keep the general public informed of its work by means of special displays, seminars and related activities.

During the fiscal year 1983-84, the annual budget for NeFRC was approximately $4.3 million which included funding for salaries, operation and maintenance and capital expenditures for a full time staff of 74 person years comprised of 26 professional and 56 technical and administrative support staff. In addition to its headquarters buildings located in St. John's, the Centre also maintains a greenhouse complex in Mount Pearl and field stations at Badger and Pasadena in the central and western parts of the province.

The principal activities of the Centre are conducted under four areas of responsibility:

- Forest Resources and Environmental research includes studies of soils, wetland and heathland ecology, reforestation, tree growth, forest genetics, environmental foresty and the effects of atmospheric pollutants on vegetation.
- The Centre's forest protection program conducts research on the development of pest management strategies and guidelines, on the biology of pest species and natural control factors. In addition it conducts forest insect and disease surveys to detect, to monitor and forecast geographic distribution and intensity and to assess damage.
- The Forestry Development branch is primarily responsible for activities associated with the federal-provincial forestry agreements and various job creation programs. It participates in the development, planning and implementation of agreements as well as providing economic analysis and evaluation of agreement activities.
- Technology Transfer and Public Information Service Unit coordinates and facilitates the technical information exchange activities conducted by the Centre. In addition, the unit is responsible for providing editorial, press relations and information to the general public.

W.J. Carroll,
Regional Director

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MANAGEMENT, ADMINISTRATION AND TECHNICAL SERVICES
REGIONAL DIRECTOR — W.J. CARROLL

MANAGEMENT, ADMINISTRATION AND TECHNICAL SERVICES
REGIONAL DIRECTOR — W.J. CARROLL

Project 1101
Service Management and Support
Project Leader: W. J. Carroll

Objectives: To ensure efficient planning and management of the research and development activities of NeFRC; to ensure effective use of financial and staffing resources to achieve stated goals and objectives; to ensure that NeFRC activities are responsive to regional needs and priorities and concerns of the Government of Canada.

Achievements Current Year: A number of staff participated in a variety of university and special training courses and two research officers were granted educational leave. Staffing progressed for the Forest Development Section. A total of six new employees were hired and two employees were promoted to senior positions at other CFS locations. Job creation activities in cooperation with CEIC were expedited and field stations at Pasadena and Badger were renovated.

Projections: Complete staffing of the Forestry Development Section; hold consultation meetings at major centres throughout the province to highlight silviculture and forest ecology studies; hold two meetings of the Canada-Newfoundland Joint Forest Research Committee.

PROJECT 1401
Financial Service
Project Leader: R. F. Best

Objectives: To provide financial, consulting and accounting advisory services to NeFRC management; to ensure adequate internal control of finances, provide a complete range of accounting services and maintain adequate accounting records.

Achievement Current Year: Responsibilities increased over FY82/83 due to the forestry development agreements which were taken over from DREE. Field and desk audits were carried out on all job creation, Summer Canada and NEED projects. Financial status reports were provided to Managers on a monthly basis and the AFMAS system was updated to provide more detailed information.

PROJECT 1501
Administrative Services
Project Leader: R. F. Best

Objectives: To ensure effective administrative services for personnel, office services, materiel management, purchasing, records, field and other facilities.

Achievements Current Year: Headquarters buildings and field stations continued to be upgraded with improvements made to landscaping, fences, walkways, parking areas, meeting and research facilities. The AES 7200 word processing system was established and on-the-job training arranged for operators. The possibility of implementing a computerized inventory at the local level was investigated and input was made to headquarters on the capital replacement strategy for furniture, equipment and vehicles. Personnel services continued to provide Pay and Benefits as well as coordination during student

recruitment, training, classification, staff relations and employee appraisals. Internal mail handling facilities were improved and the departmental file classification system was implemented.

Projections: Improvements of headquarters and field facilities will continue, especially with respect to personnel safety. Other administrative areas will continue ongoing activities and when feasible, improvements will be introduced to improve efficiency.

PROJECT 2104
Research Support Services
Project Leaders: A.B. Case and J. Hudak

Objectives: To provide an efficient and high quality support service to meet the needs of the NeFRC research and development programs.

Achievements Current Year:

1. **Mycological herbarium** — Additional specimens were collected and a slide collection on the most common and important diseases was prepared.

2. **Insect reference collection** — New insect specimens from the Labrador coast were added and a computerized listing of the reference collection was prepared.

3. **Plant herbarium** — Herbarium materials were improved to National Herbarium Standards, a computerized accessions listing was prepared and accessibility was increased.

4. **Seed and planting stock service** — Seedling production continued at the nursery in Pasadena and willow production in support of the ENFOR program was maintained.

5. **Chemical and physical analysis laboratory** — Analyses of soils, plants and water continued in support of NeFRC and other agencies. A methods manual was prepared for 22 laboratory procedures and a data base management software package was introduced.

6. **Computer services** — The PDP 11/44 computer system became fully operational. A new system disk and operating system were installed and Data Treive II was installed and operated on a trial basis.

7. **Greenhouse facility** — Approximately 60% of the facility was utilized as sections became fully operational.

8. **Library** — Most of its monographic series from the Oxford to Library of Congress System was recatalogued.

Projections: Additional improvements will be made to existing mycological herbarium and a reference list of diseases of forest trees will be published. The insect reference will be further expanded. Guidelines will be produced to aid field staff when collecting and preparing specimens for the plant herbarium. Regular activity will continue at the Pasadena Nursery and in the Chemical and Physical Analyses Laboratory. The newly installed Data Trieve II system will be promoted and additional computer services specific to graphics routine will be further developed. The Greenhouse facility will be further developed and library services will continue as required.

PROJECT 2604
Technology Transfer and Public Information Services
Project Leader; D.R. Rex

Objectives: To conduct a forestry relations program designed to improve awareness of ongoing research and development programs among client agencies, to promote an understanding of the wide use of forest resources among the general public and to publish and disseminate scientific and technical information.

Achievements Current Year: In 1983, logistical and technical support was provided during program review sessions, silviculture symposium, CIF annual meeting, National Forest Week, Environment Week and public consultation meetings. Technical assistance to educators, students and the general public continue to be a major part of the program. This included providing forestry lectures at schools, participation at a three-day science seminar, and responding to approximately 1000 individual requests for assistance. Liaison visits to forestry field staff of provincial government and industry were important activities as was the provision of training films and audio-visual accessories to all client organizations. Technical advice was provided to all associated committees as requested. Four editions of "Woody Points" were prepared and feedback solicited for future improvements. A program review booklet was produced, technical editing services were provided during preparation of reports, mailing lists were updated and expanded and four articles specific to urban forestry were prepared for a provincial newspaper chain.

Projections: Technology transfer and forestry liaison activities will be expanded in co-operation with individual researchers; a series of field demonstrations and study sessions will be organized for specific client groups. Four editions of "Woody Points" and a program review booklet will be produced. Technical editing and production responsibilities for information reports will continue. A series of newspaper articles on technical forestry matters will be prepared. As requested, technical assistance will be provided to all cooperating agencies during events specific to forestry.

FOREST RESOURCES AND ENVIRONMENTAL RESEARCH
PROGRAM DIRECTOR — A.B. CASE

FOREST RESOURCES AND ENVIRONMENTAL RESEARCH
PROGRAM DIRECTOR — A.B. CASE

PROJECT 2201
Environmental Factors and Forestry Practices
Project Leader: A.B. Case

Objectives: To assess and evaluate physical impacts of forest management practices on forest and other wildland ecosystems; to test ameliorative measures and provide guidelines and prescriptions illustrating resource management practices needed to maintain or increase the productivity and quality of forest and related ecosystems; to provide advisory services to resource and environmental agencies.

Achievements Current Year: Advisory services were provided to both Federal and Provincial Departments of Environment through participation on the Energy/Environment Strategy Committee and Assessment Advisory Committees. Representation on the Biomass Development Committee continued in 1983. Resource road and silvicultural proposals submitted under the General Development Agreement (GDA) for forestry were screened in committee. Revisions to the report "Environmental Guidelines for Resource Road Construction" were initiated.

Projections: To continue participation on Provincial Assessment Advisory Committees and Environmental Assessment Review Process (EARP), Environmental Screening Committee and to complete revision of report "Environmental Guidelines for Resource Road Construction".

List of Studies:

1. Environmental assessment of forestry practices
2. Services to FEARO/RSCC

PROJECT 2202
Environmental Impact of Atmospheric Pollutants
Project Leader: S.S. Sidhu

Objectives: To assess the effects of industrial pollutants on vegetation and soils; to develop ameliorative measures and guidelines to minimize the effects of air pollution; to evaluate the adequacy of existing air quality standards for the protection of terrestrial ecosystems in Newfoundland; to advise provincial government and industry on experimental design and sampling techniques for monitoring effects of pesticides on vegetation and soils; to develop strategies for assessing the effects of simulated acid rain on forests and soils in Newfoundland.

Achievements Current Year: Advisory services were provided to Newfoundland Department of Environment, ERCO Industry, and EPS (DOE). Vegetation and air were monitored in the Long Harbour area. Also, joint field trips to the Long Harbour area were undertaken in cooperation with Newfoundland DOE, ERCO, and Boyce Thompson Institute, Ithaca, N.Y. A short-term study on the effects of fluoride on seeding and fruiting success was undertaken. A journal paper on the effects of simulated acid rain on pollen germination was published in the Canadian Journal of Botany. A paper on the buffering capacity of

foliage of several boreal species was presented at the Acid Rain and Forest Resources Conference.

Projections: To continue monitoring fluoride damage to vegetation and soil near the phosphorus plant; to complete a paper on the relationship of F-damage symptoms and foliar F-accummulation to F-flux in air measured by fluoridation plates; to complete a paper on the effect of fluorides on flowering and fruiting success in tree species; to initiate greenhouse experiments on the effect of acid rain on soil and plant growth.

List of Studies

1. Advisory services to environmental agencies
2. Effects of atmospheric emissions on vegetation and soils.

PROJECT 2204
Forest and Plant Ecology
Project Leader: W.J. Meades

Objectives: To determine the ecological relationships between major vegetation types of Newfoundland and Labrador and their natural environment; to develop an increased understanding of the reaction of major vegetation types to man's activities; i.e., drainage, logging and fire; to increase knowledge of autecology of species having particular importance in Newfoundland and Labrador; to apply the data bank generated from such studies to forest and other land management problems; to provide leadership and technology transfer in ecological land classification and peatland development.

Achievements Current Year: Classification of peatlands in eastern Canada has been completed. An experimental design was completed to research factors controlling tree growth on drained peatlands for future afforestation trials. Regional peatland classifications were integrated into National Wetland Classification. A report on the habitats of the Grey River caribou range was completed and phenology studies were initiated. A new study to produce environmental sensitivity maps for logging operations was initiated in cooperation with the Lands Directorate (DOE). A paper on research considerations in herbicide use for forestry was presented to the Silviculture Newfoundland Symposium. Consultation with the Newfoundland and Labrador Wilderness and Ecological Reserves Council was maintained. A poster presentation on boreal forest soils of Newfoundland and their potential for growth of larch was given at the Sixth North American Forest Soils Conference. A paper on Atlantic Salt Marshes and their soils was given at an international meeting and a summary of results was published. Three chapters on Soils, Peatlands and Heathlands were published in a book titled "The Biogeography and Ecology of Newfoundland". Reports on the ecoregions of Newfoundland and Labrador were submitted to the Canada Committee on Ecological Land Classification (CCELC) for publication in the Atlas of Canada. A symposium on Peatland Inventory Methodology was held in cooperation with the Lands Resource Research Institute, Agriculture Canada. An invited paper on Peatland Classification in Canada was given at the International Symposium on Mire Classification at Oulu, Finland.

Projections: To establish a peatland afforestation experimental site; complete draft chapter on "Peatlands of Atlantic Canada" for CCELC book on "Wetlands

of Canada"; initiate new study on the impact of ericaceous shrub expansion on cutovers in central Newfoundland; develop methodology for classifying burnt and cutover lands in Newfoundland; initiate a contract study on the effect of nitrogen-fixing symbionts on the growth of tree seedlings; publish an information report on caribou rangelands; complete study on mapping of environmental sensitivity for logging operations; prepare a report on salt marshes of Newfoundland and Labrador; prepare a journal paper on the ecology of larch; prepare an information report on the larch resource; produce a forest site classification manual for central Newfoundland; begin editorship of a book on geobotany in cooperation with Junk Publishers, The Hague.

List of Studies

1. Ecological investigations of wetlands
2. Ecological investigations of heathlands
3. Forest classification, ecology and mapping
4. Autecological studies of major trees, shrubs and related plants
5. Ecology of Newfoundland soils

PROJECT 2301
Tree Seed and Improvement Research
Project Leader: J.P. Hall

Objectives: To evaluate the productive potential through species and provenance testing, breeding and selection of various native and exotic tree species suitable for reforestation in Newfoundland; to provide technical assistance and services to provincial government and industry in Newfoundland and to outside agencies to ensure that research findings are translated into economic and environmental gains.

Achievements Current Year: Native species — Results on the genetics of cone morphology of **black spruce** have been submitted for publication. A publication was prepared on the wood density growth rate relationship. A journal publication incorporating results from all measurements on a **white spruce** provenance trial was prepared and a 25-year remeasurement was completed. The program of inter- and intra-provenance hybridizations was continued, more crosses were made, and seed from the 1982 crosses were sown in the greenhouse. Pollen development studies in native species were continued. **Exotic species** — results from **red spruce** and **Sitka spruce** provenance trials were published. Pollen development studies in exotic species were continued. **Advisory services** — Advisory services to the Tree Improvement Working Group were continued.

Projections: Native species — Continue remeasurement of black spruce provenance trials; continue crosses to complete number of families for black spruce inbreeding study; continue testing of flower-induction methods; test methods for screening out low-density trees in plus-tree selection trials; analyze 25-year data from white spruce provenance trial and continue controlled pollinations within and among provenances; continue hybridizations in larch and complete data collections for the pollen-formation studies. **Exotic species** — Continue remeasurements of red spruce and Sitka spruce provenance trials; remeasure species trials and continue introduction of exotic species.

List of Studies

1. Genetic improvement of native conifers
2. Genetic improvement of exotic species in Newfoundland
3. Advisory services to the tree improvement working groups

PROJECT 2302
Forest Renewal Research
Project Leader: J. Richardson

Objectives: To develop and demonstrate silvicultural techniques required to overcome site problems adversely affecting forest productivity on each of the major forest, peatland, and heathland types; to determine techniques for maximizing forest productivity through intensive management involving reforestation and silvicultural treatments.

Achievements Current Year: Additional regeneration plots were established on balsam fir cutovers to assist in the development of regeneration stocking standards for Newfoundland. Field aspects of the study of the potential of large-scale aerial photography for regeneration surveys were completed by the consultants. Experimental shelterbelts were established in cooperation with the Parks and Recreation Department, City of St. John's. Papers on boreal agroforestry R & D and on native and exotic willows were presented to the Canadian National Committee (International Peat Society), Natural History Society of Newfoundland, and to the University of Minnesota and Minnesota Department of Natural Resources. An illustrated book on the genus **Carex** was published. The cooperative series of planting stock comparison trials has been expanded to 11 trials on recently disturbed sites. The organization of the major silviculture symposium was successfully completed, several papers on forest regeneration were contributed to the symposium, and the proceedings have been edited and prepared for publication. The inter-agency stand reclamation working group completed its work with the presentation to the Management Committee for the Forestry Subsidiary Agreement of the report containing recommendations and guidelines for stand reclamation.

Projections: A preliminary report on stocking standards for black spruce and balsam fir will be developed, and stem density-volume relationships will be developed for balsam fir and revised for black spruce. A field test will be designed to compare methods of Kalmia control in preparation for tree planting. Advisory services will continue in support of the development and assessment of the proposed joint forestry herbicide program, and other aspects of forestry herbicide use in Newfoundland. Monitoring and tending of cooperative plantation trials will be coordinated, existing survival and growth data will be analyzed, and a formal plan for data handling and publication will be developed with the preparation of at least one publication. A publication will be prepared on the results of recent remeasurements of the peatland plantations in central Newfoundland and the work in the regeneration research demonstration area at North Pond will be published, and a continuous growth data updating program will be initiated. Preliminary surveys of wind flow patterns will be conducted and a long-term cooperative research program will be developed to study those aspects of the planetary boundary layer influencing forest productivity.

List of Studies

1. Potential of large scale aerial photography for surveying forest regeneration
2. Competition control on forest sites
3. Influence of biometeorological factors on forest productivity
4. Development of regeneration stocking standards for Newfoundland and Labrador
5. Silvicultural workshops and demonstrations
6. Plantation research

PROJECT 2303
Tree and Stand Growth
Project Leader: R.S. van Nostrand

Achievements Current Year: Detailed radial growth measurements were completed for all black spruce discs of the stem analysis trees; the data, along with other relevant growth-plot information, were entered into the computer data bank ready for processing. Two new pre-commercial thinning experiments were established — one each in dense young black spruce and balsam fir stands. Work continued on the analyses and results of the respiration and growth data.

Projections: To complete the analyses of the forest fertilization trials and prepare a report for publication; to establish two new pre-commercial thinning experiments and apply fertilizer to two previously established experiments; to publish a technical report on the construction and use of a xylometer; to begin a new study designed to predict tree and stand growth for silviculture and management application.

List of Studies
1. Influence of stand density and fertilization on productivity of natural and planted stands.
2. Forest productivity on cutovers
3. Predicting tree and stand growth for silviculture and management applications

PROJECT 2501
Energy from Forest Biomass
Project Leader: R.S. van Nostrand

Objective: To determine the feasibility of harvesting and using forest biomass for energy production in Newfoundland; to develop long-term strategies for the utilization of biomass for energy; to develop methods and techniques for biomass inventory and management; to assess environmental impacts of biomass harvesting and methods of reforestation.

Achievements Current Year: A study to estimate the domestic fuelwood consumption on the island of Newfoundland was completed. Preliminary investigation towards calibration of the FORCYTE growth model was completed. Growth and mortality were measured among trees planted and seeded on the whole-tree harvested area (P-145), and analyses of data were completed. The **Salix** energy plantation work was expanded through mass propagation of selected energy clones and by conducting regional geographic and market potential studies. A review of recent commercial and industrial wood-peat energy development in Atlantic Canada was completed and a report prepared. Four poster sessions depicting ENFOR projects carried out in Newfoundland during 1983-84 were presented at the 1984 Bioenergy R & D seminar in Ottawa. Energy R & D priorities for Atlantic Canada were established in collaboration with Maritimes Forest Research Centre and the office of the Regional Director General. In-

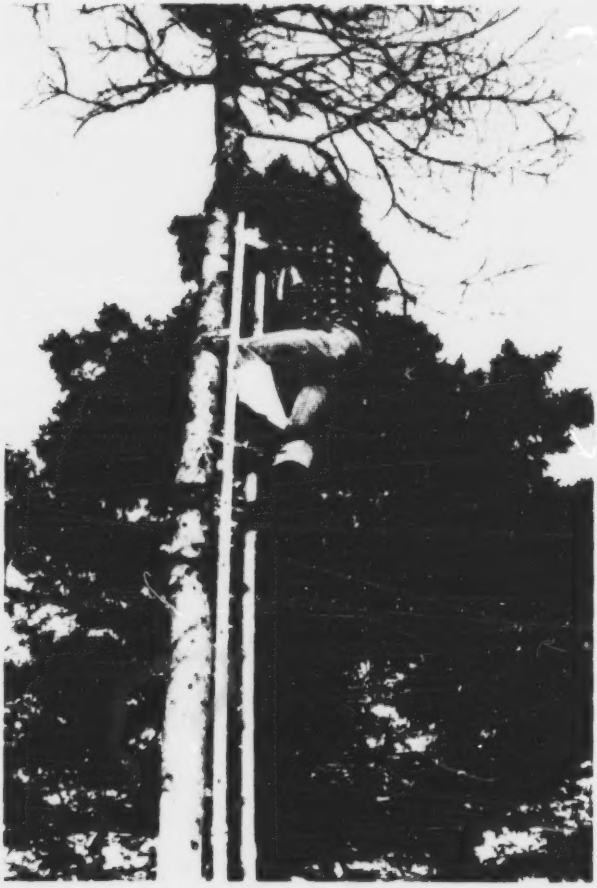
house project reviews were held and ENFOR project proposals for 1984-85 were prepared.

Projections: To further expand the **Salix** energy plantation work, one or two biomass plantations will be established in central Newfoundland to obtain data necessary to calibrate the FORCYTE growth model; to establish a study to determine the optimum interval between harvesting and establishment of softwood stand in relation to possible changes in soil moisture, nutrient status and vegetation; to evaluate the economic benefits that accrue to silviculture through whole-tree harvesting; to assess the impact of whole-tree harvesting on the development of natural regeneration; to develop ENFOR project proposals for 1985-86.

List of Studies:

1. Reforestation after whole tree chipping for hog fuel
2. Boreal Energy Plantation R & D
3. Domestic fuelwood consumption in Newfoundland
4. Testing the FORCYTE growth model for Newfoundland forest types

FOREST PROTECTION RESEARCH
PROGRAM DIRECTOR — J. HUDAK



FOREST PROTECTION RESEARCH
PROGRAM DIRECTOR — J. HUDAK

PROJECT 2402
Pest Biology Research
Project Leader: A.G. Raske

Objective: To develop effective and practical methods for measuring population levels of forest pests and their natural control factors; to investigate the biology of pest insects and diseases including their population dynamics; to assess insect and disease impacts on major age classes of forest trees and stands; to develop methods to prevent or minimize forest losses.

Achievements Current Year: Population levels of the spruce budworm were measured for the ninth complete generation in 1983; a sampling system for younger budworm larvae and one for older larvae have been published; also a report documenting a massive moth flight from New Brunswick into Newfoundland was prepared. The incidence of biological control factors (predators, parasites, and diseases) in 1983 budworm populations was determined. Several representative damaged stands in central Newfoundland were surveyed, and data collected to assess the impact of the spruce budworm on forest succession. Balsam Woolly aphid populations were sampled in areas of immature balsam fir in western Newfoundland. Hemlock looper larvae were reared for a study to identify the sex pheromone of the hemlock looper. The severity of Armillaria root rot in damaged black spruce stands was examined. Thirty balsam fir trees were sampled to determine the rate of sap rot penetration, casual organism of sap rot and physical and chemical changes in wood characteristics of budworm-killed fir. Harvesting losses on salvage logging concentrated on the assessment of mechanical operations. Cull survey data were transferred to computer in Newfoundland from Ottawa and computer programs were written to compute new volume tables incorporating defect factors. A total of 17 permanent plots were established in black spruce stands to monitor progress of deterioration of black spruce and to provide study areas for research on the cause of spruce decline and mortality. The biology and life history of the four-eyed spruce bark beetle were investigated in central Newfoundland. The biology and life history of the larch beetle were investigated on the Avalon Peninsula. Special meetings have been held for discussions of insects in parks, nursery insects, and their impact and control.

Projections: Data collected on budworm populations for several seasons will continue to be analyzed and results prepared for a major budworm symposium. The percent mortality of spruce budworm by native organisms will continue to be monitored. Attempts to introduce exotic budworm parasites will continue and two parasites from Europe are expected in 1984. The impact of the budworm on both semi-mature and immature stands will continue to be monitored on permanent plots. Tree ring analysis to determine increment loss due to budworm defoliation will continue and more trees will be cut in 1984 for growth loss analysis. Data on the vulnerability of different forest stands will continue to be analyzed and a report on the results prepared for publication. Data from the Bowater CFI plots have been analyzed in relation to budworm damage and a report should be published in 1984. Data on Armillaria root rot on damaged spruce will be collated and a report published. Data on the permanent plots to study the impact of the spruce budworm on forest succession will be prepared

for publication. Studies on the effect of insects on cone and seeds will continue with emphasis of insects on black and white spruce. Balsam wooly aphid populations will be monitored in several stands in western Newfoundland and past data on stand development obtained for more than 10 years will be analyzed. Investigation into the identity and synthesis of the hemlock looper pheromone will continue. The work on the rate of deterioration of wood by microorganisms and its effect on physical and chemical properties of pulp and paper will be continued for fir and will be expanded to include budworm-killed black spruce. Data on salvage-logging losses will be collected again, and the Shigo metre will be tested as a tool to measure stress in insect-damaged trees. The identification of fungus cultures will continue. Biological investigations of the four-eyed spruce beetle will continue. An attempt will be made to determine the role of the beetle in the death of spruce trees by spraying trees likely to be attacked by the bark beetle with insecticides.Some aspects of the biology of the larch beetle will be continued, primarily the study of flight musculature breakdown and buildup in relation to brood development and brood establishment. The major flight periods of the eastern spruce beetle and some of the major brood mortality factors in Newfoundland will be determined. The 17 permanent plots in black spruce will be monitored especially in relation to the four-eyed bark beetle population fluctuation. Some trees in or near these plots will be sampled to determine some basic tree physiology parameters such as ability of the trees to store food, to mobilize food reserves, and reactions to Armillaria root rot.

List of Studies:

1. Cone and seed fungi of softwoods
2. Insect damage to cone and seeds of softwoods
3. Development of damage from balsam wooly aphid in balsam fir stands
4. Sex peromone(s) of the eastern hemlock looper
5. Armillaria root rot
6. Deterioration of trees damaged by insects
7. Decay, microflora and wood quality of living trees
8. Role of woodborers in tree defoliation
9. Population studies of the spruce budworm
10. Influence of weather on populations of the spruce budworm
11. Role of predators, parasites and diseases on the population dynamics of the spruce budworm.
12. Impact of spruce budworm on immature stands
13. Impact of spruce budworm on semi-mature stands
14. Impact of spruce budworm on cones and seeds
15. Impact of spruce budworm on wildlife forage
16. Impact of spruce budworm on forest succession

PROJECT 2404
Biological Control Research
Project Leader: K.P. Lim

Objectives: To develop effective biological control of forest pests; to evaluate the effect of chemical insecticide(s) on biological control agents of forest pests; to investigate the potential use of entomogenous nematode as a biological control agent of forest pests.

Achievements Current Year: European pine sawfly — A nuclear polyhedrosis virus was applied against newly hatched larvae. **Mountain-ash sawfly** – No parasite emerged from previous year's rearing. A total of 130 females of **Olesicampe geniculatae** was released in a field cage and about 60,000 host larvae were added to the cage. **Entomogenous nematode** — two research contracts were conducted by Memorial University of Newfoundland. These are (1) "Feasibility of the use of a rhabditid nematode for the control of the spruce budworm". Greenhouse experiments were conducted successfully by applying aqueous suspension of the nematode, **Heterorhabditis heliothidis,** to spruce budworm larvae on small balsam fir trees. (2) "Alternate sources of steinernematid nematode".

Projections: More emphasis will be placed on aspects of life history of parasitoid insects and host-parasitoid interactions. **European pine sawfly** — The nuclear polyhedrosis virus will be introduced into new spot infestations if necessary. The effectiveness of last year's introduction will be monitored; additional larval parasites of the **Mountain-ash sawfly** will be introduced from Quebec and released into field cages; **Hemlock looper** — The effectiveness of the introduced tachinid, **Winthemia occidentis** will be monitored; scientific authority on research contracts on entomogenous nematodes will be provided.

List of Studies:

1. Populations of biological control agents
2. Control of forest insect pests with nematodes.

PROJECT 2601
Forest Insect and Disease Survey
Project Leader: P. Singh

Objectives: To conduct systematic surveys of forest pest conditions, determine the extent of infestations, assess the impact, forecast impending conditions, and recommend control measures and when necessary evaluate the effectiveness of direct control measures; to provide forest pest data and related information for the National Forest Resource Data program of Canada.

Achievements Current Year: The annual general detection, monitoring, appraisal and forecast of forest insects and diseases were completed, the data anlayzed and interpreted, and presented to forest resource managers in the form of publications, reports, and at special seminars and meetings. Special pheromone trap surveys were conducted in cooperation with Agriculture Canada to monitor the possible introduction of the gypsy moth and forest tent caterpillar. A special survey of Armillaria root rot was conducted in black spruce stands damaged by spruce budworm. Requests from the forest industry, parks and the general public for information on identity and control of pests of forest, shade and ornamental trees and shrubs were satisfied by providing verbal and written advice. Soil samples were collected across the Island and along the coast of Labrador to isolate native nematodes for biological control of forest pests. Information leaflets on eight important forest pests were prepared for publication jointly with the Dept. of Forest Resources and Lands.

Projections: Continue surveys for detecting, appraising and forecasting forest pest conditions in general and with special emphasis on spruce budworm, hemlock looper, balsam wooly aphid, black army cutworm, scleroderris canker, and general pest conditions in forest improvement areas; disseminate information to forest agencies and the general public through written papers, reports, seminars, workshops and verbal communications, provide information on forest pests for inclusion in national publications; cooperate with the Dept. of Forest Resources and Lands in the publication of information leaflets on common forest pests of Newfoundland.

List of Studies:

1. Detection and forecasting forest pest conditions

FOREST DEVELOPMENT
PROGRAM DIRECTOR — J.A. MUNRO

FOREST DEVELOPMENT
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PROJECT 3101
Management and Common Support
Project Leader: J.A. Munro

Objectives: To provide management and common support services to the Forest Relations and Economic Development Branch at NeFRC; to discharge the economic analysis and development responsibilities of the branch.

Achievements Current Year: Recruitment was successfully completed for the positions of Senior Development Officer, Resource Development Officer and Development Officer, bringing the implementation side of the Development Branch up to full strength. The position of Economics Technician and Computer Operator was also filled. The Senior Socio-economic Analyst position was filled on an acting basis. The position of Economic Analyst remains to be filled.

Projections: Provide managerial and common support services for the Forest Relations and Economic Development Branch. Complete staffing to bring the branch up to full strength of eight person years.

List of Studies

Nil

PROJECT 3202
Statistical Services
Project Leader: G. Milne

Objectives: To improve and update the existing computer information system; to develop a computer information system to meet the requirements for the development agreements; to develop a computer data base for FORSTATS; to further the graphics capabilities of the existing system and to meet the requirements for individual computer needs.

Achievements Current Year: The statistics programs were improved and made user friendly. The users were then given instructional periods in proper operation of the economics programs. A demonstration of the graphics capabilities presently available to NeFRC was given, and provided upon request. The data for the statistics programs were updated to the most current available information. Three FORSTATS surveys were processed this year; seed procurement, nurseries and silviculture. Several computer programs were written in support of the Development Branch economics and implementation activities.

Projections: Continue to update and improve regional forestry and forest industry statistics adding any new programs as they are required; create a computer information system for the development agreement related data with the use of software DI-3000; improve graphics capabilities; create data base for

Newfoundland FORSTATS information; publish an updated "Newfoundland Forest Facts"; create programs as required by the Development Branch; improve existing Economics programs.

List of Studies

Nil

PROJECT 3203
Advice and Consultation Services
Project Leader: G.R. Milne

Objectives: To provide economic advisory services to federal government departments, provincial authorities and industry for establishing sound forest resource development programs in Newfoundland and in the establishment of priorities for research and development activites at CFS.

Achievements Current Year: Economic advisory services were provided to government agencies and industry as required through verbal transmission of information to clients at meetings and regular channels of written correspondence.

Projections: To continue to provide the service as requested.

List of Studies:

Nil

PROJECT 3204
Economic Studies
Project Leader: G.Milne

Objectives: To conduct applied research studies in forest economics, directed towards particular resource management problems and opportunities in Newfoundland.

Achievement Current Year: Short-term economic studies were carried out as required. Major studies on the economic impact of the wood industries sector have been completed. A directory of woodworking firms has been published. A study on the economic impact of spruce budworm losses was initiated in cooperation with forest protection staff at NeFRC.

Projections: Conduct short-term analyses in support of advisory and consultation services as required; complete industry research through a study describing the economic importance of the entire Newfoundland forest industry; complete study on the economic impact of the spruce budworm; complete staffing of vacant economist position; develop iong-term economics research program of resource related problems using input from government and industry.

List of Studies

1. Short-term economic analyses
2. Forest resource economic research
3. Forest Industry economic research

PROJECT 3603
Policy Implementation - Development Agreements
Project Leader: J.M. Butler

Objectives: To discharge federal responsibilities for the implementation and evaluation of Forestry Subsidiary Agreements in Newfoundland; to plan for a new federal-provincial cost shared agreement; to provide federal forestry leadership in the development, implementation and evaluation of forestry job creation projects; to facilitate the transfer of new technology into the forestry sector in Newfoundland.

Achievements Current Year: Managerial and evaluation responsibilities were continued for the Forestry Subsidiary Agreement. Management and evaluation responsibilities continued for the FESP Program. The CFS continued implementation and monitoring of the Unemployment Insurance Job Creation (UI/JC) and NEED programs.

Projections: Continue with managerial and evaluation responsibilities for the Forest Subsidiary Agreement. Complete planning for a new federal-provincial cost shared agreement to be implemented in 1985-86; implement the forestry portion of the Environment 2000 job creation program in Newfoundland; assist in the transfer of technology from outside Newfoundland - particularly in the areas of silviculture, wood products development, and forest inventory.

List of Studies

1. Forestry Subsidiary Agreement Implementation
2. Employment Stimulation Programs
3. Forest Technology Transfer
4. Forest Subsidiary Agreement Evaluations
5. Planning for a New Forest Subsidiary Agreement for Newfoundland

NEWFOUNDLAND FOREST RESEARCH CENTRE
EXPENDITURES ($000s) 1983/84

Program Areas	PY	Salaries	N.E.E.D. Program	C.E.I.C. Program	Development Agreement	S.C.S.E.P.	O&M	Capital	Totals
Management	5.5	193.2				17.9	37.7	12.5	261.3
Administration	15.3	389.8					162.3	66.4	618.5
Forest Resources	32.8	1,052.6					404.9	245.4	1,702.9
Forest Protection	22.6	678.1					249.4	99.5	1,027.0
Forest Development	7.3	228.9	429.2	408.5	12,877.3		111.9	54.1	14,109.9
Technology Transfer/ Information Services	1.0	35.5					38.1	8.3	79.7
ENFOR						17.9	302.2		302.2
TOTAL	84.5	2,575.9	429.2	408.5	12,877.3	17.9	1,306.5	486.2	18,101.5

*Includes 34 COSEP Students seasonally employed.

STAFF LIST AND ORGANIZATION 1983-84

Regional Director - Dr. W.J. Carroll — Secretary - E.E. Manuel

FOREST RESOURCES AND ENVIRONMENTAL RESEARCH
Program Director - A.B. Case

Chemical and Physical Analysis Laboratory	J.-G. Zakrevsky, E.M. Pike, E.R. LeBreton
Forest Ecology - Impact Assessment	Vacant
Forest Ecology - Succession	W.J. Meades, A.R. Van Kesteren
Wetland Ecology	E.D. Wells, S.M. Morgan
Forest Ecology - Soils/Autecology	B.A. Roberts
Silviculture - Forest Regeneration/Hardwood Control	J. Richardson, V.D. Chaffey
Silviculture - Mensuration, Biomass, Fertilization	R.S. van Nostrand, J.G. Donnelly
Silviculture - Stand Development	P. Newton
Tree Biology - Forest Genetics	Dr. J.P. Hall, W.J. Curran, P. Tricco
Tree Biology - Forest Genetics	Dr. M.A.K. Khalil, L. May
Ecophysiology/Stand Modelling	M.B. Lavigne
Pollution Ecology - Air Pollutants and Toxic Chemicals	Dr. S.S. Sidhu, C.T. French
Herbarium Curator	S.M. Morgan
Nursery Services	C.H. Evans
Biogeography/Biometeorology	A.W. Robertson
Greenhouse and Projects	G.J. Mills

FOREST PROTECTION RESEARCH
Program Director - Dr. J. Hudak

Insect Populations	E. Dobesberger, J. Carter
Entomology - Cone and Seed Insects	Dr. R.J. West, D. Durling
Entomology - Damage and Impact	Dr. A.G. Raske, J.D. Rowe
Entomology - Biological Control	Dr. K.P. Lim, L. Oldford
Mycology, Pathology, Insect & Disease Survey	Vacant, G. Carew
Wood Deterioration & Decay	G.R. Warren, J.P. Meades, A.L. Fudge, J.W. Marshall
Computer & Statistical Analysis	R.G. Hunter
Forest Insect & Disease Survey	L.J. Clarke, K.E. Pardy, E.D. Banfield, D.S. O'Brien, W.J. Sutton, D.M. Stone

FORESTRY DEVELOPMENT BRANCH
Program Director - Dr. J.A. Munro

Senior Economist	G.R. Milne
Senior Development Officer	J.M. Butler
Forest Development Officer	W. Alexander
Forest Development Officer	L. West
Secretary	M. Power

TECHNOLOGY TRANSFER/PUBLIC INFORMATION SERVICES

Head - D.R. Rex

ADMINISTRATION

Chief, Finance & Administration	(Acting) W.F. Walsh
Finance	E.C. Higdon, M.A. Martin, C. Prior
Purchasing	F.L. Bannister
Personnel	J.A. Landrigan
Library	C.E. Philpott
Central Registry	L.J. Fennelly
Office Services	M.F. Gillingham, B. Bartlett, E. Cooper
Field Station Facilities	W.V. Bonnell

PUBLICATIONS

Alexander, A.L. 1983. Woodfuel utilization - "Nova Scotia Forest Industries." Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(4):6-7.

Alexander, W.L. 1984. Forest management, fact or fiction. Can. For. Serv., St. John's, Nfld. For Res. Newsl., Woody Points 13(1):7-8.

Butler, J.M. 1983. Regeneration surveys from the air using large scale aerial photography. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(1):3-4.

Carew, G.C. 1984. Septoria leaf spot new to Newfoundland. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 13(1):3.

Case. A.B. 1983. Reduction of biomass losses - a global overview. Can. For Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(1):2.

Clarke, L.J. and Carew, G.C. 1983. Forest Insect and Disease Conditions in Newfoundland and Labrador in 1982. Dept. Environ., Can. For. Serv., St. John's, Nfld. Inf. Rep. N-X-214. 21 p.

Clarke, L.J. and Carew, G.C. 1984. Forecast of forest insect and disease conditions in Newfoundland and Labrador in 1984. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 13(1):3.

Clarke, L.J. and Carew, G.C. 1983. Forest insect and disease conditions in Newfoundland and Labrador in 1983. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(4):1-5.

Clarke, L.J. 1983. Black army cutworm - a new pest of spruce plantations. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(3):2.

Dobesberger, E.J. and Lim, K.P. 1983. Required sample size for early instar larvae of spruce budworm (**Lepidoptera: Tortricidae**) in Newfoundland. Can. Ent. 115:1523-1527.

Dobesberger E.J., Lim, K.P. and Raske, A.G. 1983. Spruce budworm (**Lepidoptera: Tortricidae**) moth flight from New Brunswick to Newfoundland. Can. Ent. 115:1641-1645.

Dobesberger, E.J. and Lim, K.P. 1983. Population levels and biological mortality factors of spruce budworm, **Choristoneura fumiferana** (Clem.), in balsam fir, **Abies balsamea** (L.) Mill., stands in Newfoundland during 1982. Dep. Environ., Can. For. Serv., St. John's, Nfld. Inf. Rep. N-X-218. 18 p.

Hall. J.P. 1983. Exotic tree species in Newfoundland forestry. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(1):6.

Hall, J. Peter 1983. Comparison of the growth of larch with other conifers on reforested and afforested sites in Newfoundland. For. Chron. 59(1):14-16.

Hall, J. Peter and Harrison, C.M. 1983. A review of progress in tree improvement in Newfoundland, 67 pages. Paper delivered at Silviculture Newfoundland Symposium, Grand Falls, Nfld., 5-6 April 1983.

Harrison, C.M. and Hall, J.P. 1983. Tree improvement in Newfoundland. A future outlook, 36 p. Paper delivered at Silviculture Newfoundland Symposium, Grand Falls, Nfld. 5-6 April 1983.

Hew, C.L., Kao, M.H., So, Y.P. and Lim, K.P. 1983. Presence of cystine containing antifreeze proteins in the spruce budworm (**Lepidoptera: Tortricidae**). Ca. J. Zool. 61:2324-2328.

Hudak, J., Raske, A.G., Lim, K.P. Clarke, L.J. 1983. The spruce budworm in Newfoundland in 1983. Report prepared for the annual Forest Pest Control Forum, Ottawa, Canada, 15-17 November 1983 21 p.

Hudak, J., Raske, A.G., eds. 1984. Forest Notes. Leaflet No. 1: (Spruce Budworm, Spruce Coneworm).

Hudak, J., Raske, A.G., eds. 1984. Forest Notes. Leaflet No. 2: (Eastern Hemlock Looper, Blackheaded Budworm).

Hudak, J., Raske, A.G. eds. 1984. Forest Notes. Leaflet No. 3: (Balsam Woolly Aphid, Balsam Twig Aphid).

Hudak, J., Raske, A.G., eds. 1984. Forest Notes. Leaflet No. 4: (Birch Casebearer, Birch Leafminer).

Khalil, M.A.K. 1984. The potential of poplars for Newfoundland. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 13(1):3-4.

Khalil, M.A.K. 1984. All range black spruce provenance study in Newfoundland: Performance and genotypic stability of provenances. Silvae Genet. 33(2-3):63-71.

Khalil, M.A.K., Robertson, A.W. 1984. Conifers for biomass production. 2 volumes, IEA/ENFOR joint publication. International Energy Agency, Min. Nat. Resour., Maple, Ontario.

Khalil, M.A.K. 1984. The potential of poplars in the boreal regions; I. Survival and Growth. Silvae Genet. 33(1):1-8.

Khalil, M.A.K. 1984. The potential of poplars in the boreal regions; II. Genotypic stability and productive quality of clones. Silvae Genet. 33(1):8-11.

Langor, D. and Raske, A.G. 1984. Eastern larch beetle being studied. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 13(1):5-6.

Lavigne, M.V. 1983. Tree mass equations for common species of Newfoundland. Dept. Environ., Can. For. Serv., St. John's, Nfld. Inf. Rep. N-X-213. 40 p.

Lim, K.P. 1983. Insect colonies at the Newfoundland Forest Research Centre. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(1):1.

Lim, K.P. 1983. Cumulative degree-days for estimating peak occurrence of

fourth instar larvae of the spruce budworm, **Choristoneura fumiferana** (Lepidoptera: Tortricidae). Dep. Environ., Can. For. Serv., St. John's, Nfld. Inf. Rep. N-X-217. 8p.

Lim, K.P. 1983. A virus to control the European pine sawfly. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(4):8.

Malley, K.G. and Milne, G.R. 1983. A directory of woodworking industries in Newfoundland, 1981. Dep. Environ., Can. For. Serv., St. John's, Nfld. Inf. Rep. N-X-216. 85 p.

Milne, G.R. and Malley, K.G. 1984. The economic impact of the woodworking industry in Newfoundland, 1981. Dep. Environ., Can. For. Serv., St. John's, Nfld. Inf. Rep. N-X-220. 39 p.

Milne, G.R. 1984. The Newfoundland sawmill and planing mill industry: structure, production and impact on the provincial economy 1981/82. Dep. Environ., Can. For. Serv., St. John's, Nfld. Inf. Rep. N-X-221. 67 p.

Milne, G.R. 1984. The Newfoundland sawmill and planing mill industry: structure, production and impact on the provincial economy 1981/82. Summary Rep. 7 p.

Pardy, K.E. 1983. Biological survey - Northern Labrador. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(4).5.

Pardy, K.E. 1983. Checklist of insect specimens in the Newfoundland Forest Research centre Museum, St. John's, Nfld. Dep. Environ., Can. For. Serv., St. John's, Nfld. Inf. Rep. N-X-215. 124 p.

Pardy, K.E. 1983. Insect museum. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(1):7.

Pardy, K.E. 1984. Biosystematics Research Institute. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 13(1):8.

Raske, A.G. and Bowers, W. 1983. Four-eyed bark beetle being studied. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(3):1.

Raske, A.G. 1983. Trees react when threatened. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(4):5-6.

Richardson, J.R. 1983. Jack pine, a promising tree species. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(4):7.

Richardson, J.R. 1983. The future of silviculture in Newfoundland. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(2):3.

Richardson, J.R. 1983. Silviculture Symposium. For. Chron. 59(4):203.

Richardson, J.R. 1984. Reforestation after whole-tree chipping for hog fuel. In International Bio-energy Director and Handbook. The Bio-energy Council, Washington, D.C

Roberts, B.A. 1983. Those pine clad hills. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(1):8.

Robertson, A.W. 1983. Boundary layer climatology: a new approach to an old problem. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(2):6.

Robertson, A.W. 1983. Visualizing surface winds. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(2):7.

Robertson, A.W. 1983. Reforesting the barrens - Iceland shows the way. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(3):7-8.

Robertson, A.W. 1983. Carex in Newfoundland. Dep. Environ., Can. For. Serv., St. John's, Nfld. Inf. Rep. N-X-219. 252 p. including illustrations.

Robertson, A.W. 1984. Willow plantations in agroforestry. Span. 27(1):32-34.

van Nostrand, R.S. 1983. Pre-commercial thinning. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 12(2):4-5.

West, L. 1984. New employment expansion and development program. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 13(1):4-5.

West, L. 1984. Unemployment insurance job creation forestry sector. Can. For. Serv., St. John's, Nfld. For. Res. Newsl., Woody Points 13(1):6-7.